

What is claimed is:

1. A substrate processing apparatus comprising:
a process chamber comprising a substrate support, gas inlet, gas
energizer, gas exhaust, and a wall having a recess sized to reduce the deposition of
process residues therein.

2. An apparatus according to claim 1 further comprising a process
monitoring system capable of monitoring a process that may be conducted in the process
chamber through the recess in the wall.

3. An apparatus according to claim 1 wherein the recess originates at an
internal surface of the wall.

4. An apparatus according to claim 3 wherein the recess terminates at a
radiation permeable portion of the wall.

5. An apparatus according to claim 1 wherein the recess comprises an
aspect ratio of at least about 0.25:1.

6. An apparatus according to claim 5 wherein the recess comprises an
aspect ratio of at least about 3:1.

7. An apparatus according to claim 5 wherein the recess comprises an
aspect ratio of less than about 12:1.

8. An apparatus according to claim 1 wherein the recess comprises an
opening size of from about 0.1 to about 50 mm.

9. An apparatus according to claim 1 wherein the recess comprises a
depth of from about 0.5 to about 500 mm.

10. An apparatus according to claim 1 wherein the recess comprises a
diameter of less than about 10 times a thickness of a plasma sheath that may be formed in
the chamber.

11. An apparatus according to claim 1 wherein the wall is made from a material that is at least partially permeable to electromagnetic radiation, electrically conducting, or both.

5 12. An apparatus according to claim 1 wherein the wall comprises one or more of Al₂O₃, SiO₂, AlN, BN, Si, SiC, Si₃N₄, TiO₂, ZrO₂ and mixtures and compounds thereof.

10 13. An apparatus according to claim 12 wherein the wall comprises quartz.

14. An apparatus according to claim 1 wherein the wall comprises a plurality of recesses.

15. An apparatus according to claim 1 wherein the wall further comprises a masking portion having the recess therein.

20 16. An apparatus according to claim 1 further comprising an electromagnetic field source adapted to maintain an electromagnetic field about the recess.

17. An apparatus according to claim 16 wherein the electromagnetic field source comprises an electrical or magnetic field source.

25 18. A substrate processing apparatus comprising:
(a) a chamber having a support, gas inlet, gas energizer, and exhaust, and a wall; and
(b) means for reducing the formation of process residue on the wall,

30 whereby a substrate held on the support may be processed by process gas introduced by the gas inlet, energized by the gas energizer, and exhausted by the exhaust.

19. An apparatus according to claim 18 further comprising a radiation permeable portion that may be used to monitor a process being conducted on the substrate.

20. An apparatus according to claim 19 wherein the means controls an access of energized gas species to the radiation permeable portion.

21. An apparatus according to claim 18 wherein the means comprises one or more recesses in the wall.

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22. An apparatus according to claim 21 wherein the recesses comprise an aspect ratio of at least about 0.25:1.



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23. An apparatus according to claim 18 further comprising a process monitoring system to monitor radiation passing through the wall.

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24. A method of processing a substrate in a chamber, the method comprising:

- (a) placing the substrate in the chamber;
- (b) providing an energized gas in the chamber to process the substrate; and
- (c) providing a recess in a wall of the chamber, the recess being adapted to reduce the formation of process residue therein.

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25. A method according to claim 24 comprising passing radiation through a radiation permeable wall portion adjacent the recess.

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26. A method according to claim 24 further comprising passing the radiation through material comprising one or more of Al_2O_3 , SiO_2 , AlN , BN , Si , SiC , Si_3N_4 ,

TiO_2 , ZrO_2 and mixtures and compounds thereof.

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27. A method according to claim 24 comprising directing radiation onto the substrate, measuring radiation reflected from the substrate, or both.

28. A method according to claim 24 further comprising applying an electrical or magnetic field about the recess.

29. A method according to claim 24 further comprising providing a wall having a masking portion with the recess therein.

30 A substrate processing apparatus comprising:
a process chamber comprising
a substrate support,
a gas inlet,
a gas energizer,
a gas exhaust, and
a wall comprising a recess originating at an internal surface of
the wall, the recess having an aspect ratio sized to reduce the deposition of process
residues therein.

10 31. An apparatus according to claim 30 further comprising a radiation
permeable portion in the recess, and a process monitoring system capable of monitoring a
process that may be conducted in the chamber through the radiation permeable portion.

15 32. An apparatus according to claim 30 wherein the recess comprises an
aspect ratio of at least about 0.25:1.

33. An apparatus according to claim 30 wherein the recess comprises a
passageway inclined at an angle of less than about 90 degrees.

200 34. An apparatus according to claim 30 wherein the wall comprises one
or more of Al₂O₃, SiO₂, AlN, BN, Si, SiC, Si₃N₄, TiO₂, ZrO₂ and mixtures and compounds
thereof.

25 35. An apparatus according to claim 30 comprising a plurality of
recesses.

36. An apparatus according to claim 35 wherein the recesses are
arranged to pass therethrough radiation originating from the plasma or radiation reflected
from different portions of the substrate.

37. A substrate processing apparatus comprising:
a process chamber comprising a substrate support, gas inlet, gas
energizer, gas exhaust, and a wall having a recess that is sized to reduce the deposition of
process residues therein;
a magnetic field source adapted to maintain a magnetic field near the
5 portion of the wall having the recess; and
a process monitoring system capable of monitoring a process that
may be conducted on a substrate in the process chamber through the recess in the wall.

38. An apparatus according to claim 37 wherein the magnetic field source
10 comprises one or more permanent magnets or electromagnets.

39. An apparatus according to claim 37 wherein the recess extends to a
radiation permeable portion in the wall.

40. An apparatus according to claim 37 wherein the process monitoring
system evaluates an attribute of radiation emanating from the chamber and passing
through the recess and the radiation permeable portion.

41. An apparatus according to claim 37 wherein the recess comprises an
20 aspect ratio of at least about 0.25:1.

42. An apparatus according to claim 37 wherein the wall is made from a
material that is at least partially permeable to electromagnetic radiation, electrically
conducting, or both.

43. An apparatus according to claim 37 further comprising an electrical
field source adapted to maintain an electrical field near the portion of the wall having the
recess.

44. A substrate processing apparatus comprising:
a process chamber comprising a substrate support, gas inlet, gas
energizer, gas exhaust, and a wall having a recess that is sized to reduce the deposition of
process residues therein;

5 the recess; and

a process monitoring system capable of monitoring a process that
may be conducted on in the process chamber through the recess in the wall.

45. An apparatus according to claim 44 wherein the electrical field source
10 comprises an electrode abutting the wall.

46. An apparatus according to claim 44 wherein the recess extends to a
radiation permeable portion in the wall.

15 47. An apparatus according to claim 46 wherein the process monitoring
system evaluates an attribute of radiation emanating from the chamber and passing
through the recess and the radiation permeable portion.

20 48. An apparatus according to claim 44 wherein the recess comprises an
aspect ratio of at least about 0.25:1.

49. An apparatus according to claim 44 wherein the wall is made from a
material that is at least partially permeable to electromagnetic radiation, electrically
conducting, or both.

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50. An apparatus according to claim 44 further comprising a magnetic
field source adapted to maintain a magnetic field near the portion of the wall having the
recess.

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51. A substrate processing apparatus comprising:
a process chamber comprising a substrate support, a gas inlet, a gas
energizer, a gas exhaust, and a sidewall about the support, the sidewall having at least one
recess sized to reduce the deposition of process residues therein.

52. An apparatus according to claim 51 further comprising a second recess in the sidewall.

53. An apparatus according to claim 51 wherein the recess is inclined relative to the sidewall.

54. An apparatus according to claim 53 wherein the recess is inclined from about 50 degrees to about 60 degrees relative to the sidewall.

10 *Surf* 55. An apparatus according to claim 51 further comprising a process monitoring system capable of monitoring a process that may be conducted in the process chamber through the recess in the wall.

15 56. An apparatus according to claim 51 wherein the recess originates at an internal surface of the sidewall.

20 57. An apparatus according to claim 56 wherein the recess terminates at a radiation permeable portion of the sidewall.

25 58. An apparatus according to claim 51 wherein the recess comprises an aspect ratio of at least about 0.25:1.

59. An apparatus according to claim 51 wherein the recess comprises an opening size of from about 0.1 to about 50 mm.

25 60. An apparatus according to claim 51 wherein the recess comprises a depth of from about 0.5 to about 500 mm.

30 61. An apparatus according to claim 51 wherein the sidewall comprises a plurality of recesses.

62. An apparatus according to claim 51 wherein the sidewall comprises a plurality of recesses on opposing sides of the support.

63. An apparatus according to claim 51 wherein the sidewall further comprises a masking portion having the recess therein.

64. An apparatus according to claim 51 further comprising an electromagnetic field source adapted to maintain an electromagnetic field about the recess.

65. A method of processing a substrate in a chamber, the method comprising:

- (a) placing the substrate in the chamber
- (b) providing an energized gas in the chamber to process the substrate;
- (c) providing a recess in a sidewall of the chamber; and
- (d) passing radiation through the recess.

66. A method according to claim 65 comprising passing the radiation through a radiation permeable wall portion adjacent the recess.

67. A method according to claim 65 wherein (d) comprises directing radiation onto the substrate, measuring radiation reflected from the substrate, or both.

68. A method according to claim 65 wherein (d) comprises passing radiation through a first recess and onto the substrate and detecting reflected radiation passing through a second recess.

69. A method according to claim 65 wherein the recess is adapted to reduce the formation of process residue therein.